Safe Recreational Lake Waters II

Protection and warning against faecal bacteria and toxic algae in bathing lakes

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Safe Recreational Lake Waters II:

Protection and warning against faecal bacteria and toxic algae in bathing lakes

the international water association

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Keywords

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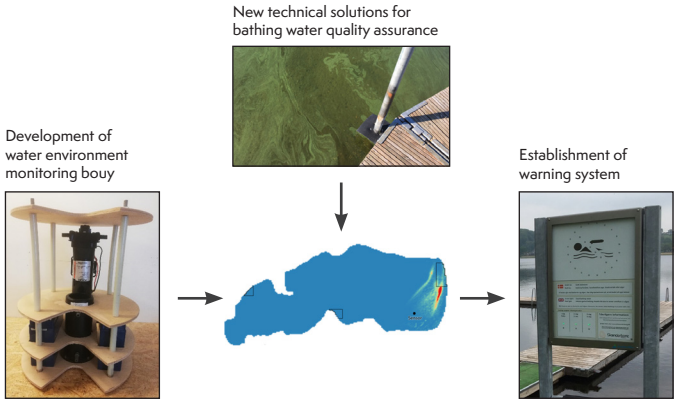
storm water overflow
monitoring and warning system



Background

Closer population density in the cities and climate changes results in overload of the combined sewer systems leading to sewage overflows to nearby lakes, rivers and seas. Similarly, algae blooms more frequently than before – some of which are toxic blue-green algae. The combined threat of faecal bacteria and algae reduces the bathing water quality and risk the health of humans and animals. Currently, the responsible authorities only have few tools available for predicting, preventing and alerting the bathers and ensuring their safety.

Concept

The project Safe Recreational Lake Waters II aims at: monitoring bathing water quality in bathing lakes (both increased concentrations of pathogen bacteria and algae bloom) **warning** system of comprised bathing safety in real time to bathing guests **combating** toxic microorganisms in the water with new technologies.

In Denmark where the project takes place, almost 5000 combined sewer overflow structures are registered, of which many leads to recreational freshwater recipients. It is estimated that 25 – 40 % of recipients with recreational value can benefit from solutions developed during the project.

Demonstration summer 2021

A demonstration event is to take place in the summer 2021. The monitoring device will be placed in the lake, and transmit data in real-time for further processing. Lake water samples will be collected both by the monitoring device and by hand for additional testing. Additional samples are taken during a heavy rainfall both in the lake and directly at the overflow to compare the faecal lake input and impact on the bathing water quality.

A warning board is to be installed on the lake-beach during the demonstration period. The board will inform guests about the water quality and any potential health risks caused by sudden algae bloom or wastewater overflow.

Results

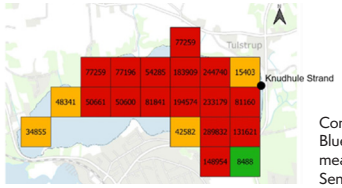
A monitoring device is developed to monitor algae bloom. The device is built as a modular system, which ease exchange of relevant sensors, and is combined with a module for automatic water sampling. Focus for this device is to ensure reliable measurements with a minimum of maintenance, hence the device has a unique construction that ensures both robustness and overcoming issues of sensor fouling – all in combination with low energy consumption. The monitoring device is equipped with a Long Range (LoRa) data transmission system that transmit data for further processing.

A hydrographical model is developed for predicting the movement and impact of faecal bacteria and cyanobacteria in the lake based on data from the monitoring device, weather and satellite data, as well as the hydrodynamics of the lake. Although the model is lake specific, only minor changes are necessary for transferring the model to other freshwater lakes.

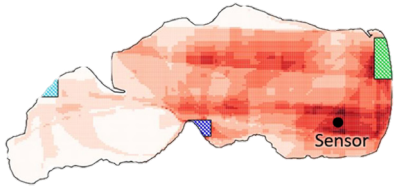
A satellite verification analysis using the ESA Sentinel-3 satellite is used to site select the best location for the monitoring buoy. Analysis of one year data has identified the best location with the highest likelihood of detecting algae.

The warning system is based on input from the hydrodynamic model, water level logging of sewer overflow and data from the monitoring device. Thereby, the warning system ensures supervision of health risks from both algae bloom and faecal bacteria while keeping the bathing area accessible for the highest numbers of days possible. The developed model applies machinelearning algorithms to ensure that the collected measurements are automatically assimilated in the model for it to be continuously improved. I case of need for warning, the alert will immediately be presented directly by the bathing area for all bathers to see so no bathers risk being exposed to harmful bacteria, virus or toxic algae.

Combating cyanobacteria with natural bacteriophages. Some cyanobacteria, also called blue-green algae, produces a substance that are toxic to fish, birds and mammals. A blooming event is often difficult to predict and may happen suddenly, and currently we have no mitigating tools. The natural enemies of the toxic cyanobacteria, bacteriophages, will be tested as a new innovative technology, and may be relevant as a tool for acute control of algal blooms.



Concentration of Blue Green algae measured with Sentinel 3A



Optimal placement of monitoring buoy based on one year of satellite measurements

Partners

The project is funded by the Danish Eco-Innovation Program under the Ministry of Environment of Denmark.
The project is a cooperation between Skanderborg Utility, NIRAS, Aquasense, Aalborg University and Danish Technological Institute.

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